CHBE 602
Spring 2010
Physicochemical Hydrodynamics
MWF 11-11:50am

Course objective: Provide the tools for analysis of problems involving diffusive and convective transport of heat and mass. Analytical and numerical solutions to steady-state and transient diffusion and conduction problems will be described. Simultaneous heat and mass transfer with chemical reaction or phase change, mixing and particulate processes will be addressed.

Instructor: Prof. Sibani Lisa Biswal
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713-348-6055
Abercrombie B240
Office Hours: Wednesday 12-1 pm or by appointment

Key Dates:

Mid Term – February 24th, 2010
Final Exam – sometime during finals period (April 28-May 5, 2010)

Grading of Course:

Homework:	25%
Project:	15%
Midterm:	30%
Final:	30%

Course Prerequisites:

Undergraduate course in transport processes or instructor permission

Homework:

You may work/consult on homework sets with your classmates but ultimately you must turn in your own work. You are NOT allowed to copy a classmate's homework directly ask or give your homework to a classmate to "consult" answers.

Honor Code:
Academic dishonesty will not be tolerated. Failure to comply with the University's policy will result in an "F".

http://honor.rice.edu/index.cfm

Web Page:
This course uses Owl Space. Please go to: http://owlspace-ccm.rice.edu/
The page includes:
Copies of problem sets and problem set solutions
Announcements
Your grades
Contact information

Textbooks:
Bird, R.B., Stewart, W.E, and Lightfoot, E.N., Transport Phenomena, 2nd ed., Wiley, 2002

Deen, W.M. Analysis of Transport Phernomena

Other transport references:
Probstein., Physicochemical Hydrodynamics.

Middleman, S., An Introduction to Mass and Heat Transfer.

Leal G., Advanced Transport Phenomena.

Carslaw, H.S. and Jaeger, J.C., Conduction of Heat in Solids.

Crank, J., The Mathematics of Diffusion.

Cussler, E.L., Diffusion.

Math references:
Bender, Advanced Mathematics for Scientists and Engineers

Greenberg M., Foundations of Applied Mathematics

Guidelines on Problem Solving:

1. Identify and describe the phenomenon of interest. Often the exact nature of the problem is not clear at the outset.

2. Draw and label a diagram of the problems, identify some of the key processes. Frequently a good picture can really help unravel the difficulties and shape the formulation of an approach.

3. Give a clear statement of the goals of the model.

4. State clearly the assumption you choose to make regarding the physics and the geometry. Your choices define your model.

5. Apply the appropriate physical principles.

6. Solve the resultant equations.

7. Compare the predictions of your model to reality.

8. Make sure that you clearly identify the solution (box it).

9. If necessary, modify the assumptions in hope of improving the degree to which your model mimics reality.

Course Topics:

Formulation, Scaling, and Approximation Methods

- Conservation equations for scalar quantities
- Scaling and order-of-magnitude analysis
- Similarity method
- Perturbation methods
- Integral method

Solution Methods for Conduction and Diffusion Problems

- Finite Fourier transform method
- Properties of Fourier series
- Steady-state and transient boundary-value problems

Convective Heat and Mass Transfer

- Laminar internal flow: entrance and fully developed regions
- Mechanical energy and viscous dissipation
- Laminar external flow: boundary layer analysis
- Buoyancy-driven flow (free convection)

Multicomponent Energy and Mass Transfer

- Conservation of energy in multicomponent systems
- Simultaneous heat and mass transfer
- Multicomponent diffusion in gases

Special Topics

- Particulate flows
- Crystallization
- Turbulent mixing